Mem. Natn. Sci. Mus., Tokyo, (7), September 20, 1974

A Revision of the East Asian Species of the Genus *Chalcophora* (Coleoptera, Buprestidae), with Special Reference to their Distribution and Differentiation

By

Yoshihiko KUROSAWA*

黒沢良彦*：東亜産ウバタマムシ属の分布地理学的知見による再検討

In 1935, J. OBENBERGER recognized five species of the genus *Chalcophora* SOLIER, 1833, from East Asia, that is, *C. japonica* GORY, *satzumae* LEWIS, *yunnana* FAIRMAIRE, *zoufali* OBENBERGER, and *nonfriedi* OBENBERGER (Sbornik entom. odd. Nar. Musea v Praze, 13, pp. 5–11). However, his materials from the Far East, especially those from the Ryûkyûs and Formosa, were not sufficient for making up a full revision of the East Asian species of the genus. In 1963, having recognized some local differentiation within *C. japonica* and *yunnana*, the author regarded *satzumae* LEWIS, 1898, described from southern Kyûshû, Japan, as a subspecies of *C. yunnana* FAIRMAIRE, 1888, described from Yunnan, South China (Iconographia insectorum Japonicorum colore naturali edita, 2, Coleoptera, p. 147). As regards *zoufali* and *nonfriedi*, the author could not express his opinion owing to the lack of materials, although he had some doubt on the identification made by J. OBENBERGER in 1935.

In March, 1973, the author had a chance to examine the type series of these two species preserved in the collection of the National Museum in Prague, Czechoslovakia. A detailed study on these type series convinced the author the fact that *nonfriedi* is the northwestern race of *yunnana* in China, and that *zoufali* is nothing but *C. alternans* ABEILLE DE PERRIN, 1904, known from Asia Minor, Syria and Caucasus. It is doubtful that such a western species as *alternans* actually occurs in eastern Asia, so that it seems better to exclude *zoufali* (=*alternans*) from the oriental fauna. Accordingly, only two species having many local races occur in eastern Asia. The variations of these two species are especially interesting in the Ryûkyû Archipelago, because the geological history of the archipelago seems to reflect upon their local differenciation. It is also of great interest that none of the species of this genus have been known in the area extending from Persia to the western Himalayas.

The author must express his sincere gratitude to many gentlemen for their kind loan of the material used in the present study, and to Mr. R. D. POPE and Miss C. M. VON HAYEK of the British Museum (Natural History), Mr. A. DESCARPENTRIES of the Museum National d'Histoire Naturelle, Paris, Dr. A. ČEJCHAN, Dr. J. JELINEK, and Dr. Z. MLYNÀŘ

* Department of Zoology, National Science Museum, Tokyo
国立科学博物館 動物研究部

of the National Museum in Prague, and Dr. S. BILY of Charles University, Pargue, for their kind permission and cooperation for studying the type series. He also greatly indebted to Dr. R. ISHIKAWA and Dr. S.-I. UÉNO of the National Science Museum, Tokyo, for their kind cooperation in the course of the present study, and to Mr. A. SHINOHARA for his excellent photography.

All the holotypes described in the present paper are preserved in the National Science Museum (Nat. Hist.), Tokyo.

Genus **Chalcophora** SOLIER, 1833

Chalcophora SOLIER, 1833, Ann. Soc. ent. France, 2, p. 278, pl. 10, fig. 9.
Buprestis ESCHSCHOLTZ, 1829, Zool. Atlas, p. 18 (nec LINNÉ, 1758).

Type-species: *Buprestis mariana* LINNÉ, 1758.

Range: Two species occur in East Asia, five in the Mediterranean area, and more than ten species in the New World, from North America to the northern part of South America, including the Great Antilles.

Key to the Species of the Genus *Chalcophora* in East Asia:

I. — Apex of each elytron somewhat sinuate or obliquely truncate, with the sutural angle acute or dentate; scutellum usually invisible, rarely visible....*japonica* (GORY, 1840)

I'.— Apex of each elytron semicircularly or arcuately emarginate, with the sutual angle sharply dentate; scutellum always visible.....*yunnana* FAIRMAIRE, 1888

Chalcophora japonica (GORY, 1840)

Buprestis japonica GORY, 1840, Monogr. Bupr., Suppl., 4, p. 81, pl. 14, fig. 77.
Chalcophora japonica: E. SAUNDERS, 1871, Cat. Bupr., p. 12.

The scutellum is usually invisible, but rarely reappears. This aberrant form was named by A. THÉRY in 1936 as ab. *scutellaris* (Bull. Soc. ent. France, 41, p. 119). The type specimen of this form, now preserved in the collection of the Museum National d'Histoire Naturelle, Paris, was collected by Dr. S. ASAHINA at Mt. Takao-san, Tokyo. The author examined a female collected by the late Dr. T. ESAKI at Kagoshima City, Kyûshû, on July 19th, 1918, which is now preserved in the collection of Kyûshû University. The sides of elytra are usually more or less strongly denticulate in the posterior third, but rarely entirely unarmed. This aberrant from is ab. *inermis* Y. KUROSAWA, nov. (fig. 3). The type-specimen of this form, now preserved in the collection of the National Science Museum, Tokyo, is a male collected by Mr. A. URATA at Izuhara, Tsushima, in June, 1958.

Key to the Races of *C. japonica* GORY:

1. — Elytral costae sharply defined; second and third intercostal areas rather uniformly punctate at the central third, with the intervals hardly elevated.....2.
— Elytral costae not sharply defined; second and third intercostal areas irregularly punctate at the central third, with the intervals irregularly and partly elevated.....4.
2. — Intercostal areas strongly and confluently punctate; first costa sharply elevated; elytra

usually greenish.....*japonica oshimana* SCHÖNFELDT, 1890

— Intercostal areas sparsely punctate; elytra usually cuprescent.....3.

3. — Elytra with the apices strongly and sharply dentate, the sides strongly denticulate posteriorly, costae stronger and more sharply elevated, and the punctuation of the intercostal areas denser at the central third; body less lustrous.....
.....*japonica bourgoini* OBENBERGER, 1935

— Elytra with the apices not so strongly and sharply dentate, the sides weakly denticulate posteriorly, costae less sharply elevated, and the punctuation of the intercostal areas sparser at the central third; body more lustrous.....
.....*japonica chinensis* (SCHAUFFUSS, 1879)

4. — Elytra with the costae stronger, the punctuation on the second and third intercostal areas stronger and more irregular, with the intervals irregularly elevated, and the apices sharply dentate and produced.....5.

— Elytra with the costae weaker, the punctuation on the second and third intercostal areas weaker and less irregular at the central third, and the apices somewhat sinuate or obliquely truncate, with the sutural angles slightly dentate.....
.....*japonica japonica* (GORY, 1840)

5. — Body brighter; punctuation on the second and third intercostal areas finer and sparser with intervals less elevated.....*japonica kumejimana* Y. KUROSAWA, nov.

— Body darker; punctuation on the second and third intercostal areas coarser and denser with the intervals strongly and irregularly elevated.....6.

6. — Apices of elytra not so strongly produced...*japonica takarajimana* Y. KUROSAWA, nov.

— Apices of elytra sharply and strongly produced...*japonica miwai* Y. KUROSAWA, nov.

subsp. **japonica** (GORY, 1840), s. str.

(Figs. 1, 2; Pl. 19: 1, 10)

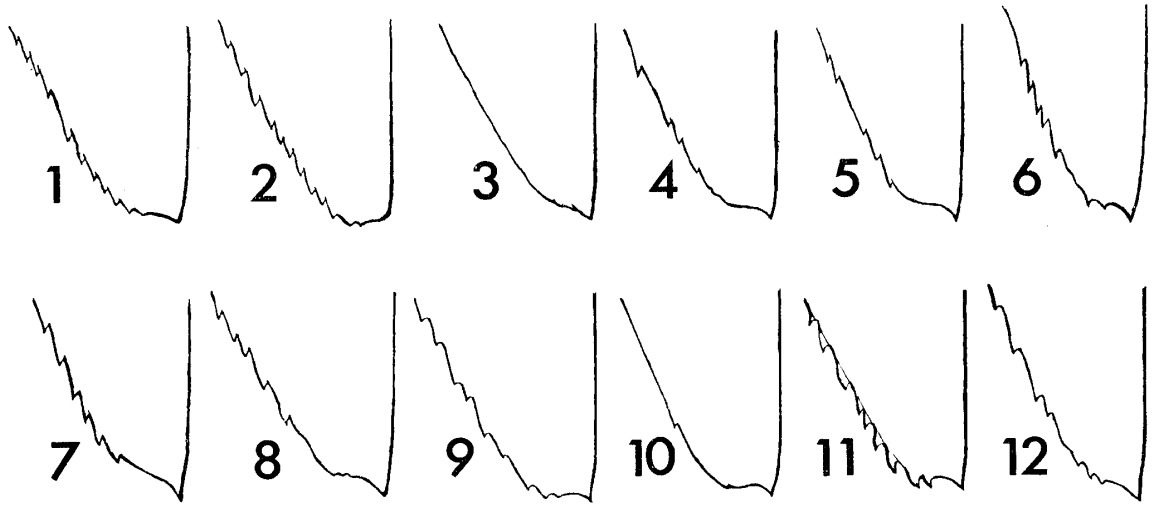
Body somewhat larger than in any other races; above dark bronzy, sometimes with a slight cuprescent or greenish tinge; scutellum usually invisible; elytra with the costae weaker, not sharply defined, more obscure, intercostal areas sparsely punctate, the punctuation on the second and third intercostal areas weaker and less irregular at the central third, and the apices sinuate or obliquely truncate with the sutural angles slightly dentate.

Length: 28.5–38.2 mm; width: 10.0–13.2 mm.

Range: Japan (Honshû, Sado, Izu Is., Shikoku, Oki, Kyûshû, Iki, Tsushima, Yakushima, Tanega-shima), Tokara group of the Ryûkyûs (Nakano-shima), Quel-part I., Korea, North China (Shantung Prov.), Minami-Daitô-jima (=South Borodino I.) (imported), Bonin Is. (imported).

The materials from the Bonin Is. and Minami-Daitô-jima, a small island lying in the Pacific about 300 km east of the Island of Okinawa, are perfectly identical with those from the main islands of Japan. They may be artificially imported from Japan proper with pine wood in a recent historical age.

It is very interesting that though a female specimen from Nakano-shima, a volcanic



Figs. 1–12. The elytral apices of *Chalcophora japinica* GORY.
1: *japonica* ♀, Kushimoto, Kii Peninsula, Japan, 2: *japonica* ♀, do., 3: *japonica* ab. *inermis* ♂, Izuhara, Tsushima, Japan, 4: *takarajimana* ♂, Takara-jima, Tokara Is., Ryûkyûs, 5: *miwai* ♀, Iriomote-jima, Yaeyama Is., Ryûkyûs, 6: *miwai* ♀, do., 7: *miwai* ♂, Dandan, Formosa, 8: *miwai* ♂, Hori, Formosa, 9: *oshimana* ♀, Naze, Amami-Oshima, Ryûkyûs, 10: *chinensis* ♂, Ning-po, China, 11: *bourgoini* ♂, Granville, Tonkin, 12: *bourgoini* ♂, Panamnao, N. Thailand.

island in the Tokara group of the Ryûkyûs, is identical with typical *japonica*, those from Takara-jima, also a small volcanic island in the southern part of the same island-group, are different from this subspecies and are closely similar to subsp. *miwai* m. of the Yaeyama group of the Ryûkyûs and Formosa.

The author also examined a female specimen collected by Mr. Y. YANO at Mt. Laoshan, near Tsingtao, Shantung prov., China.

subsp. **takarajimana** subsp. nov.

(Fig. 4; Pl. 19: 4)

Chalcophora japonica tokarana CHÛJÔ, 1970, Mem. Fac. Educ. Kagawa Univ., (II), (192), p. 17 (nom. nud.)

Dark aeneous, with costae blackish, sometimes with a slight cuprescent or cyanescent tinge; elytra with the costae strongly elevated, and the punctuation on the second and third intercostal areas rather strong and irregular, with the intervals irregularly elevated and the apices sharply dentate, though not so strongly produced as in *miwai* m.

Length: 27.5–29.0 mm; width: 9.2–13.0 mm.

Range: Tokara group of the Ryûkyûs (Takara-jima).

Holotype (♂), allotopotype (♀), and paratopotypes: 7♂♂, 1♀, Takara-jima, Tokara Is., Ryûkyûs, 21. vii. 1961, Y. HAMA lgt.; paratypes: 1♂, 2♀♀, do., 30. v. 1953, T. NAKANE lgt.; 3♂♂, do., 5–7, vii. 1960, Y. HAMA lgt.; 1♀, do., 6. vi. 1962, M. SATÔ lgt., 2♂♂, do., 20. vii. 1964, S. OHGA lgt.

This subspecies stands closer to subsp. *miwai* m. from Formosa and the Yaeyama group of the Ryûkyûs than to subsp. *japonica* GORY from the main islands of Japan.

subsp. **kumejimana** subsp. nov.

(Pl. 19: 6)

Body smaller and slenderer than in the other races; above bright aeneocuprescent; elytra with the costae strongly elevated, the punctuation on the second and third intercostal areas stronger and more irregular than in *japonica,* and the intervals irregularly elevated, but finer and sparser than in *takarajimana* and *miwai.*

Length:, 29.3–31.0 mm; width: 9.7–10.8 mm.

Range: Okinawa group of the Ryûkyûs (Kume-jima).

Holotype: ♀, Kume-jima, Ryûkyûs, 1. viii. 1926, C. NAGAOKA lgt.

A female specimen labelled "Ishigaki-jima, 21. vii. 1928, S. HIRAYAMA" bought from the late Mr. S. HIRAYAMA of Tokyo, is fairly identical with the holotype in all the features. His label is, however, rather doubtful.

subsp. **miwai** subsp. nov.

(Figs. 5–8; Pl. 19: 2)

Chalcophora yunnana MIWA (nec FAIRMAIRE), 1936, Cat. Coleopt. Japonicorum, 1, Bupr., p. 4.
Chalcophora yunnana insularis MIWA (nec THÉRY), 1936, 1. c., p. 4.
Chalcophora japonica yayeyamana CHÛJÔ, 1970, Mem. Fac. Educ. Kagawa Univ., (2), (192), p. 17 (nom. und.).

Dark aeneous, with the costae black; closely resembling subsp. *takarajimana* m. in many features, but different from it in the shape of the apices of elytra which are sharply and strongly produced.

Length: 26.0–38.5 mm; width: 8.6–13.0 mm.

Range: Formosa, Yaeyama group of the Ryûkyûs.

Holotypes and paratopotypes: 6♂♂, Suburbs of Hori, C. Formosa, vi. 1965; allotype and paratypes: 4♀♀, Honbukei, suburbs of Hori, 25. vi. 1961, T. SHIRÔZU lgt.; paratypes: 1♂, Dandan, Formosa, 27. v. 1926, T. KANO lgt.; 1♀, Formosa (without eaxct data), T. KANO lgt.; 1♀, Musha, C. Formosa, 25. iv. 1927, T. KANO lgt.; 2♀♀, Hori, vii. 1958; 1♀, Mt. Sôzan, N. Formosa, 3. v. 1940, C. SAITÔ lgt.; 1♀, Musha, viii, 1942; 1♀, Hori, 18. vii. 1940; 1♀, do., v. 1961; 1♀, Peito, N. Formosa, 20. iv. 1964, E. HAMANO lgt.; 2♂♂, C. Formosa, vi. 1965.

Dr. Y. MIWA who resided in Formosa before the World War II, determined this form as *C. yunnana* FAIRMAIRE. This error caused the second error that he thought the similar form from Ishigaki-jima of the Yaeyama group to be *C. yunnana insularis* THÉRY described from Amami group of the Ryûkyûs.

The specimens from the Yaeyama group of the Ryûkyûs have no distinctive character separating them from this Formosan race. The author examined the following specimens from the Yaeyama group.

1♂, Ishigaki-jima, vii. 1938, S. NOMURA lgt.; 1♂, Kawarayama, Ishigaki-jima, 27. vii. 1937, K. MORISHITA lgt.; 1♂, do., 10. vi. 1971, Y. NISHIYAMA lgt.; 1♀, Ishigaki-jima, 2.

viii. 1955, R. KANÔ lgt.; 1♀, do., 7. viii. 1962, Y. WATANABE lgt.; 2♀♀, Mitara, Iriomote-jima, 8. viii. 1962, M. SATÔ & Y. ARITA lgt.; 1♀, Taketomi-jima, 11. vii. 1972, H. HAYAKAWA lgt.

The name *C. japonica yayeyamana* KUROSAWA, mentioned by Dr. M. CHÛJÔ in his "Coleoptera of the Loo-choo Archipelago (II)", is the name without description.

subsp. **oshimana** SCHÖNFELDT, 1890

(Fig. 9; Pl. 19: 11)

Chalcophora japonica oshimana SCHÖNFELDT, 1890, Ent. Nachr., 16, p. 172.
Chalcophora japonica KERREMANS (nec GORY), 1909, Monogr. Bupr., 4, p. 23.
Chalcophora amabilis MATSUMURA (nec SNELLEN VAN VOLLENHOVEN), 1909, Thous. Ins. Japan, 3, p. 105, pl. 49, fig. 10.
Chalcophora satzumae YANO (nec LEWIS), 1927, Kontyû, 2, p. 60.

Body brighter, smaller and slenderer than that of *japonica*; above brighter, with the costae and reliefs cupreoaeneous or blackish, sometimes greenish, intervals and intercostal areas dark or bright green, sometimes beautiful bright bluish green, rarely greenish coppery; beneath and legs bright cupreoaeneous.

Elytra with the costae sharply defined and elevated, intercostal areas strongly, densely, confluently, and rather uniformly punctate, and the apices somewhat similar to those of *japonica*, but the sutural dentation more sharply pointed.

Length: 23.8–38.0 mm; width: 7.8–13.0 mm.

Range: Ryûkyûs (Amami-Oshima, Tokuno-shima, Kikaiga-shima, Okinoerabu-jima, ? Yoron-tô, Okinawa-hontô, Kerama-jima, Miyako-jima).

The range of this subspecies is confined to the Amami and Okinawa groups of the Ryûkyûs, except for a specimen from Miyako-jima, which is a male having many features identical with those of *oshimana* and is presumed to have been imported with pine wood from Okinawa in recent age. The specimens from the Okinawa group are usually brighter and more beautiful than those from the Amami group.

subsp. **chinensis** (SCHAUFFUSS, 1879)

(Fig. 10; Pl. 19: 5)

Buprestis chinensis SCHAUFFUSS, 1879, Nonquam otiosus, 3, p. 480.
Chalcophora chinensis: FAIRMAIRE, 1888, Ann. Soc. ent. Belgique, 32, p. 25.
Buprestis sinica JAKOBSON, 1912, Zuki Rossiji, p. 780.

Body above cuprescent, somewhat lustrous; elytra with the intercostal areas uniformly but sparsely punctate, the sides weakly denticulate posteriorly, the costae less sharply elevated, and the apices not so strongly and sharply pointed.

Length: 32.0–35.0 mm; width: 11.0–11.8 mm.

Range: Central and South China.

The punctuation of the intercostal area of this race is similar to that in *bourgoini* from Indochina and in *oshimana* from the Ryûkyûs, but is evidently different from *japonica* and its allies. In the form of the elytral apices, however, it stands closer to *japonica* from Japan, Korea and North China.

It is uncertain which area forms the transitional zone between this and Indochinese race, *bourgoini*, or between this and *japonica*.

subsp. **bourgoini** OBENBERGER, 1935

(Fig. 11, 12)

Chalcophora japonica bourgoini OBENBERGER, 1935, Sbornik entom. odd. Nar. Mus. Praze, 13, pp. 6, 10.

Body attenuate anteriorly and posteriorly, dark cuprescent; elytra with the costae sharply defined and elevated, intercostal areas uniformly but sparsely punctate, the sides strongly denticulate posteriorly, and the apices strongly and sharply dentate, but the punctuation of the intercostal areas denser at the central third than in *chinensis*.

Length: 31.0–32.0 mm; width: 10.7–11.0 mm.

Range: Tonkin, N. Thailand.

The type series of this race consists of four males from Giranville, Tonkin, collected on 17–19. xi. 1919. The author examined a male from Pa-Namnao, North Thailand, collected on June, 1964, by D. CHAIGLOM. Its occurrence is expected in northeastern Burma, North Laos and South China.

Chalcophora yunnana FAIRMAIRE, 1888

Chalcophora yunnana FAIRMAIRE, 1888, Ann. Soc. ent. Belgique, 32, p. 24.

Scutellum always visible. Elytra semicricularly or arcuately emarginate at the apex, with the sides denticulate posteriorly.

Range: Japan, Ryûkyûs, Formosa, China, Indochina, Thailand.

The range of this species is overlapped the southern range of *C. japonica*.

C. intermedia REY known from Dalmatia, Corsica and Algeria may be a western representative of this species.

Key to the Subspecies of *C. yunnana* FAIRMAIRE:

1. — Elytral costae sharply defined and elevated ..... 2.
   — Elytral costae not sharply defined and rather obsoletely elevated ..... 3.
2. — Sides of pronotum subparallel posteriorly, subangulate or rounded anteriorly; darker above ..... *yunnana yunnana* FAIRMAIRE, 1888
   — Sides of pronotum arcuately or obliquely attenuate from base to front; bright cuprescent above ..... *yunnana nonfriedi* OBENBERGER, 1935
3. — Elytral costae distinct, with the second costa distinct between the dorsal depressions ..... 4.

— Elytral costae rather obsolete, with the second costa obsolete between the dorsal depressions ..... 6.

4. — Pronotum somewhat narrower, with the sides attenuate from base to front, but more or less angulate and dilated at the anterior third and somewhat sinuate behind there ..... *yunnana nakanei* Y. KUROSAWA, nov.

— Pronotum somewhat broader, with the sides attenuate from base to front, sometimes slightly angultae and dilated at the anterior third ..... 5.

5. — Body darker, more aenescent; elytral costae more obsolete ..... *yunnana insularis* THÉRY, 1908

— Body brighter, more cuprescent; elytral costae more distinct ..... *yunnana abnormalis* MIWA & CHŪJŌ, 1935

6. — Pronotum with the sides angulate and dilated at the anterior third, and the longitudinal costae on the disk more distinct ..... *yunnana satzumae* LEWIS, 1899

— Pronotum with the sides attenuate from base to front, sometimes slightly dilated at the anterior third, and the longitudinal costae on the disk obsolete ..... *yunnana formosana* Y. KUROSAWA, nov.

subsp. **yunnana** FAIRMAIRE, 1888, s. str.

Calcophora yunnana FAIRMAIRE, 1888, Ann. Soc. ent. Belgique, 32, p. 24.

Dark aeneocuprescent, with the costae and reliefs blackish and the depressions and intercostal areas cuprescent; sides of pronotum subparallel posteriorly, angulate or rounded and more or less dilated anteriorly; elytra with the costae sharply defined and the sides strongly denticulate; apices of elytra rather arcuately or subtriangularly emarginate, with the sutural angle acute and produced and the outer angle blunt at the tip.

Length: 28.2–31.0 mm; width: 10.0–11.1 mm.

Range: South China, Tonkin, Laos, North Thailand.

This subspecies may occur in northeastern Burma. The author has examined a male specimen from Tathom, Phang, North Thailand, collected on July 26 th, 1960, by D. CHAIGLOM.

subsp. **nonfriedi** OBENBERGER, 1935, comb. nov.

Chalcophora nonfriedi OBENBERGER, 1935, Sbornik entom. odd. Nar. Mus. Praze, 13, pp. 7, 10.

Bright aeneocupreous with the costae and reliefs darker; sides of pronotum arcuately or obliquely attenuate from base to front; elytra with the costae sharply defined and the sides moderately denticulate; apices of elytra arcuately or semicircularly emarginate, with the sutural angle acute and produced.

Length: 31.0 mm; width: 11.0 mm.

Range: Central and West China, ? Tibet.

The type-specimen is a female obtained at Gifu-shan, Szechwan, West China, which was examined by the author in Prague. *C. yunnana* having the body "d'un bronze plus claire" recorded from Tibet by Ch. KERREMANS (Monogr. Bupr., 4, p. 45, 1909) and a *Chalcophora* species from Chinkiang on the Yangtze River that was said by LEWIS himself to resemble *C. satzumae* LEWIS may fall under the category of *nonfriedi*.

subsp. **formosana** subsp. nov.

(Pl. 19: 9)

Chalcophora satzumae MIWA & CHÛJÔ (nec LEWIS), 1936, Cat. Coleopt. Japonicorum, 1, Bupr., p. 4.

Dark aeneous or blackish, sometimes with a cuprescent tinge; pronotum with the sides attenuate from base to front, sometimes slightly dilated at the anterior third, and the longitudinal reliefs on the disk obsolete; elytra with the costae rather obsolete, the sides strongly serrate and denticulate in the posterior third, and the second costa obsolete between the dorsal depressions.

Length: 24.4–34.2 mm; width: 8.6–13.2 mm.

Range: Formosa.

Holotype (♂), allotopotype, and paratopotypes: 2♂♂, 4♀♀, Honbukei, suburbs of Hori, C. Formosa, 25. vi. 1961, T. SHIRÔZU lgt.; paratypes: 1♂, Hori, 1937, R. KANÔ lgt.; 1♂, Mt. Nôkô, C. Formosa, 4. v. 1940; 1♀, do., 3. vii. 1938; 1♂, Musha, 23. v. 1937; 1♀, Suisharyô, C. Formosa, 8. vi. 1961, S. UÉNO lgt.; 1♂, Formosa, viii. 1957; 1♀, Rokkiri, S. Formosa, 15. v. 1941, Y. YANO lgt.; 1♀, Hori, 15. v. 1941; 1♀, do., 23. v. 1940; 6♂♂, 4♀♀, do., 1958; 1♀, Musha, v. 1959, W. CHUNG lgt.; 1♀, 1♂, C. Formosa, 1967.

This race is rather common in Central Formosa.

subsp. **satzumae** LEWIS, 1899

(Pl. 19: 7)

Chalcophora satzumae LEWIS, 1899, Ann. Mag. nat. Hist., (6), 17, p. 334.

Calcophora yunnana satzumae: Y. KUROSAWA, 1963, Iconogr. ins. Japonicorum colore nat. ed., 2, Coleopt., p. 147.

Dark aeneous or blackish, sometimes with a slight cuprescent tinge; pronotum with the sides angulate and dilated at the anterior third and the longitudinal reliefs on the disk more distinct than that of *formosana*; elytral costae rather obsolete and not sharply defined, sides serrate in the posterior third, but the denticulation not so strong, and the second costa obsolete between the dorsal depressions.

Length: 29.0–35.0 mm; width: 10.3–12.6 mm.

Range: Japan (Honshû, Shikoku, Kyûshû, Tsushima, Yaku-shima, Tanega-shima), Bonin Is. (imported), Ryûkyûs (North Borodino I.) (imported).

The distribution of this race in Honshû is confined, at present, to the Kii Peninsula, and in Shikoku to the Pacific coast. A specimen which the author recorded from the Island of Sado (Insects Fauna of Niigata Pref., (8), Bupr., p. 33, 1964) is presumed to be a drift

from Tsushima by the Tsushima Current. The specimens from the Bonin Is. and Kita-Daitô-jima (= North Borodino I.), a small Pacific island lying about 300 km east of Okinawa, seem to have been imported with pine wood from Kyûshû.

subsp. **nakanei** subsp. nov.

Chalcophora yunnana nakanei CHÛJÔ, 1970, Mem. Fac. Educ. Kagawa Univ., (2), (192), p. 18. (nom. nud.).

Dark aeneous, sometimes with a cuprescent tinge; elytral costae distinct, but not sharply defined and rather obsoletely elevated, with the second costa obsolete between the dorsal depressions; pronotum somewhat narrower, with the sides attenuate from base to front, but more or less angulate and dilated at the anterior third and somewhat sinuate behind there.

Length: 26.5–36.3 mm; width: 9.0–12.3 mm.

Range: Tokara group of the Ryûkyûs.

Holotype, allotopotype, and paratopotypes: 5♂♂, 1♀, Takara-jima, Tokara Is., 30. v. 1953, T. NAKANE lgt.; paratypes: 5♂♂, 4♀♀, do., 21–22. vii. 1961, Y. HAMA lgt.; 1♂, do., 5. vii. 1960, Y. HAMA lgt.; 2♀♀, do., 6. vi. 1962, M. SATÔ lgt., 1♂, 1♀, do., 20 vii. 1964, S. OHGA lgt.

The author has also examined a male specimen of this race from Nakano-shima, Tokara Is. (9. vi. 1953, T. NAKANE lgt.).

subsp. **insularis** THÉRY, 1908

Chalcophora insularis THÉRY, 1908, Ann. Soc. ent. Belgique, 52, p. 78.
Chalcophora yunnana insularis: KERREMANS, 1909, Monogr. Bupr., 4, p. 45.
Chalcophora yunnana FAIRM. var. *insularis*: OBENBERGER, 1935, Sbornik entom. odd. Nar. Mus. Praze, 13, p. 7.

Bright aeneous, sometimes with a slight cuprescent tinge; elytral costae distinct, but not sharply defined and rather obsoletely elevated and more obsolete than in the next race, with the second costa distinct between the dorsal depressions.

Length: 26.7–37.1 mm; width: 9.0–12.6 mm.

Range: Amami group of the Ryûkyûs (Amami-Oshima, Tokuno-shima, Okinoerabu-jima).

The specimens from Okino-erabu-jima, an island laying between Tokuno-shima and the main island of Okinawa, are something intermediate between this race and *abnormalis*, a race from Okinawa.

subsp. **abnormalis** MIWA & CHÛJÔ, 1935

(Pl. 19: 8)

Chalcophora satzumae LEWIS var. *abnormale* MIWA & CHÛJÔ, 1935, Ent. World, 3, p. 270, pl., fig. 8.
Chalcophora yunnana YANO (nec FAIRMAIRE), 1827, Kontyû, 2, p. 60.

Chalcophora yunnana insularis MIWA (nec THÉRY), 1929, Trans. nat. Hist. Soc. Formosa, 19, p. 60.
Chalcophora yunnana abnormale: Y. KUROSAWA, 1963, Iconogr. ins. Japonicorum colore nat. ed., 2, Coleopt., p. 147.
Chalcophora yunnana abnormalis: Y. KUROSAWA, 1969, Coleopt. News, (5), p. 3.

Bright aeneocupreous or cupreous; elytral costae not sharply defined and rather obsoletely elevated, though distinct, with the second costa distinct between the dorsal depressions.

Length: 28.0–36.8 mm; width: 9.5–13.0 mm.

Range: Okinawa and Yaeyama groups of the Ryûkyûs (Okinawa, Tokashiki-jima, Miyako-jima, Ishigaki-jima, Iriomote-jima), Minami-Daitô-jima (=South Borodino I.) (imported).

It is difficult to find the distinguishing characters between the specimens from the Yaeyama group and those from the Okinawa group. The occurrence of this race in Minami-Daitô-jima (=South Borodino I.) may be the result of human import with pine wood from Okinawa. It may be worthy of notice that the races from South and North Borodino Islands are different from each other. They may be considered to have come from Japan proper and Okinawa, respectively.

Chalcophora alternans (ABEILLE DE PERRIN, 1904)

Buprestis alternans ABEILLE DE PERRIN, 1904, Bol. Soc. Esp. Hist. nat., 4, p. 212.
Chalcophora mariana: KERREMANS (nec LINNÉ), 1909, Monogr. Bupr., 4, p. 47.
Buprestis mariana alternans: JAKOBSON, 1912, Zuki Rossiji, p. 780.
Chalcophora alternans: OBENBERGER, 1913, Ent. Mitt., 2, p. 330.
Chalcophora zoufali OBENBERGER, 1924, Čas. Čs. spol. Ent., 21, p. 49 (syn. nov.).

In March, 1973, the author examined the type-series of *Chalcophora zoufali* OBENBERGER preserved in the National Museum in Prague. It consists of two males from "Jawata, Kiushiu", and a male from "Lohang, Tehse". The author does not know where is Lohang, Tehse, but Jawata (=Yawata) is the large city in northern Kyûshû (= Kiushiu), Japan. These specimens are identical with that of *C. alternans* ABEILLE DE PERRIN known from Asia Minor, Syria and Caucasus. The points that distinguish *zoufali* from *mariana* and *alternans* mentioned by OBENBERGER in 1935 fall in the range of individual variations of *alternans*. It is quite strange why such a western species was recorded from Japan. It seems better to exclude this species from the Japanese fauna.

Chalcophora angulicollis LECONTE, 1857

Chalcophora angulicollis LECONTE, 1857, Pacific Railw. Expl., 9, p. 44.
Chalcopohra montana CASEY, 1909, Proc. Wash. Ac., 11, p. 80.

The author has examined a female specimen identical with this North American species collected at Hamadera, Osaka Pref., Japan, on June 24th, 1935, by Mr. F. YANO. It must have been imported from the Pacific coast of North America with some kind of

pine wood, in the same way that *C. virginiensis* DRURY was imported from North America to Europe.

Zoogeography

In the pattern of local differenciation, there is a decided difference between the two East Asian species of the genus *Chalcophora*, that is, *C. japonica* and *C. yunnana*. The former shows a complicated pattern, especially in the Ryûkyû Archipelago, while the latter is simply divided into two types, continental and insular. The insular forms of *yunnana* are distributed along the fringing islands of East Asia, from Formosa through the Ryûkyûs to southern Japan, and are not readily classified. In the Ryûkyûs, they gradually change from southwestern *abnormalis* to northeastern *insularis* and *nakanei*, and the respective subspecies are not always clear-cut because of the existence of intermediate individuals. From these facts, it may be concluded that *yunnana* invaded the Ryûkyûs in a period later than *japonica* did. Taking the matters in a chronological order, the author is going to discuss first on the raciation of *japonica* and then on that of *yunnana*.

I. The Geographical Variation of *Chalcophora japonica* GORY.

Of the races of *japonica*, the subspecies *miwai, takarajimana, kumejimana* and *japonica* form a natural group, being characterized by irregularly punctate intercostal areas of the elytra and the irregularly elevated intervals on the second and third intercostal areas between the discal depressions. The other group of subspecies comprises *oshimana, chinensis* and *bourgoini*, which have in common uniformly punctate and not irregularly elevated intercostal areas of the elytra. The former group can be divided into two subgroups, one of which contains *takarajimana, kumejimana* and *miwai* having strongly elevated elytral costae and sharply produced elytral apices, and the other contains solely *japonica*, having not so strongly elevated elytral costae and not so sharply produced, somewhat obliquely truncate elytral apex. The latter group can also be divided into two subgroups. The subspecies *oshimana*, which has strongly, densely but uniformly punctate, greenish intercostal areas of the elytra, forms a subgroup, and *chinensis* and *bourgoini*, which have sparsely but uniformly punctate, cuprescent intercostal areas of the elytra, forms the other subgroup.

The ranges of distribution in each subspecies are as follows:

takarajimana	Tokara group of the Ryûkûys (Takara-jima).
miwai	Yaeyama group of the Ryûkyûs, Formosa.
kumejimana	Okinawa group of the Ryûkyûs (Kume-jima).
japonica	Japan (Honshû, Sado, Izu Is., Shikoku, Oki, Kyûshû, Iki, Tsushima, Yaku-shima, Tanega-shima), Tokara group of the Ryûkyûs (Nakano-shima), Korea, North China (Shantung Prov.), Bonin Is. (imported), Minami-Daitô-jima (=South Borodino I.) (imported).
chinensis	Central and South China.
bourgoini	Tonkin, North Thailand, ? Laos, ? Northeast Burma, ? South China.
oshimana	Ryûkyûs (Amami and Okinawa groups, Miyako-jima).

The most interesting phenomenon in the distribution of the races of *C. japonica* is that there occur two different subspecies, *japonica* and *takarajimana*, in different islands of the Tokara group of the Ryûkyûs. Here, the Bonins and South Borodino Island are excluded from the consideration, since both the island groups are inhabited by only typical *japonica*, which must have been imported with pine wood from the Japan proper. The other interesting fact is that there occur three distinct subspecies in the Continent.

Next to arise is the problem of strange relationship of the Ryûkyûan subspecies. *Oshimana*, a race endemic to the central Ryûkyûs, is closely related to *chinensis* and *bourgoini* of the Continent, whereas the four insular races, *miwai, kumejimana, takarajimana* and *japonica*, are mutually close to one another. This means that the existing population of the central Ryûkyûs must have had a history different from that of the other insular forms. In short, the Ryûkyûs have had a complicated geological history, which reflects upon the differentiation of *Chalcophora japonica.*

In the following lines, the characters and the pattern of variation will be given for respective races.

1. *Takarajimana* is the endemic subspecies to Takara-jima, a small island at the southernmost of the Tokara group of the Ryûkyûs. A specimen examined by the author from Nakano-shima, an island at the northern part of the same island-group, is perfectly identical with *japonica*, a race from the Japan proper and Korea. *Takarajimana* stands most closely to *miwai* from Formosa and the Yaeyama group of the Ryûkyûs, and there is no other clear character to distinguish this from *miwai* than the form of the elytral apices. It stands closer to *kumejimana*, a race from Kume-jima, an island at the western side of the main island of Okinawa, than to *japonica* from Nakano-shima of the Tokara group and the Japan proper. The most distant relative of this subspecies is *oshimana*, which is the subspecies endemic to the Amami and Okinawa groups of the Ryûkyûs including Amami-Oshima, the nearest island to Takara-jima.

2. *Miwai* is the subspecies in Formosa and the Yaeyama group of the Ryûkyûs. In the Yaeyama group, it was recorded from Ishigaki-jima, Iriomote-jima and Taketomi-jima. There is no character sufficient to discriminate the Yaeyama population as a subspecies independent from the Formosan one. The sharp apical dentation and the strongly serrate sides of elytra are similar to those of *bourgoini* from Indochina.

3. *Kumejimana* is endemic to Kume-jima, an island lying in the East China Sea about 80 km west of the Island of Okinawa. In the form of costae and punctuation in the intercostal areas of the elytra, it resembles *takarajimana* and *miwai*. There are, however, some characters showing a similarity to *oshimana*. For instance, the body is brighter than in *miwai* and *takarajimana*. There often found among the specimens from this island examples having the elytra tinged with green. This may be the result of hybridization between *miwai*, a drift from the Yaeyama group, and *oshimana*, a later invader from the main island of Okinawa.

4. *Japonica,* the northern race, is close to the three races mentioned above in the point of the elytral punctuation, but is characterized by the form of the elytral apex. In Japan, it spreads northwards to the Oga Peninsula, Akita Prefecture, along the coast of the Japan

Sea, and to the Ojika Peninsula, Miyagi Prefecture, along the Pacific coast. However, the northern limit of its range in the inland area is the Aizu District of Fukushima Prefecture. Its dispersal to Sado may have been performed in the Postglacial Age, when the Tsushima Channel opened. It is not certain whether its immigration into the Izu Islands was made on the warm current, Kuroshiwo, or not. If the dispersal to the Izu Islands occurred in a period when these islands was united with the main island of Honshû, the northward dispersal of *japonica* may have taken place very recently, probably in the Holocene, since the warm current must have curved southwards along the western side of the ancient peninsula. The specimens from Tsushima, Korea and Shantung Province, North China, cannot be separated from those of Japan. The fact that specimens having a slight greenish tinge are often found in the districts along the Pacific coast of Japan may be regarded as a proof of former existence of northward immigrants of *oshimana,* drifted from the Ryûkyûs, which had been assimilated by *japonica.* The invasion of this *japonica* into the Bonin Islands and South Borodino Island is, as mentioned above, a result of artificial import with pine wood from the Japan proper. The records of *japonica* from the Continent are uncertain, due to the current confusion between *chinensis* and *japonica.*

5. In the colour of the body and in the costae and punctuation of the elytra, *chinensis* is similar to *bourgoini*, but in the shape of the elytral apex, *chinensis* stands closer to *japonica* than to any of the other races. It is uncertain in what part of the Continent is the border between *chinensis* and *bourgoini* and in what part of North China is the boundary between *chinensis* and *japonica.*

6. *Bourgoini* described by OBENBERGER in 1935, has been known from Tonkin and North Thailand up to the present, but may also occur in Laos, South China, and Northeast Burma. The elytral punctuation of this race is similar to that in *chinensis,* but the form of the elytral apices is similar to that of *miwai* from Formosa and the Yaeyama group of the Ryûkyûs. In regard to the elytral punctuation, *chinensis* and *bourgoini* are similar to *oshimana.*

7. *Oshimana* is a peculiar subspecies among any races of *Chalcophora japonica.* Except for the continental subspecies, *chinensis* and *bourgoini*, it is isolated from any other races occurring in Formosa, the Ryûkyûs and Japan. Though *oshimana* could be regarded as a good species if it were compared only with the insular races, the difference becomes obscured when *chinensis* and *bourgoini* are put between *oshimana* and the other races from Formosa, the Ryûkyûs and Japan. It is the subspecies endemic to the Amami and Okinawa groups of the Ryûkyûs, except for Kume-jima, an island belonging to the latter group. There is no distinction to separate the materials from the Okinawa group from that of the Amami group, except for the colour pattern. Though there is a slight difference in colour pattern between the materials from these two islands groups, it is not sufficient for discriminating the two populations as different subspecies. A male specimen of this race collected in Miyako-jima may be due to an artificial immigration.

8. Excluding the specimens from the Bonin Islands and South Borodino Island, which are artificial import, the race *japonica* has no local variation over the vast area from Japan through Korea to North China. Judging from the distribution of the other groups of insects, it is natural that Yaku-shima and Tanega-shima of the Ryûkyû Archipelago have

a fauna similar to that of the Japan proper. In the Tokara group, just south of the above two islands, Nakano-shima, an island at the northern part of the group, belongs to the range of *japonica,* while Takara-jima, an island situated at the southern part, has the endemic subspecies, *takarajimana.* Although these two are the only islands of the Tokara group, in which races of *japonica* have been known up to the present, other islands of the same island-group should also harbour certain races of the species. It is to be hoped that future investigations will reveal the distributional pattern of the races more precisely and clarify the mechanism of differentiation within this interesting island-group.

The distribution of the *miwai* subgroup is also very strange. The range of that subgroup is confined to the series of islands of the inner arc of the Ryûkyûs and Formosa, such as Takara-jima, Kume-jima and the Yaeyama group. On the other hand, the range of *oshimana*, which has characters most closely ralated to the *bourgoini* subgroup ranging from central China to the Indochinese Peninsula, is confined to the limited islands of the outer arc of the Ryûkyûs, that is, the Amami and Okinawa groups. This strange relationship of the races in the species *japonica*, must have been caused by the isolation and combination of various islands of the Ryûkyû Archipelago during the geological age, especially in the Pleistocene.

In the Glacial Age, movement of insects from west to east may have been relatively easy, and northern insects must have imigrate southwards. On the contrary, it must have been very difficult for ancestral insects, in the Glacial Age, to disparse westwards or northwards. In the Ryûkyû Archipelago, south of the Tokara Strait, immigrations of wood boring insects were made either on landbridges or by the warm current, Kuroshiwo, that is always from west or from south. In interglacial ages, isolation and differenciation of races may have taken place in the archipelago. In the Continent, however, ancestral insects were driven southwards in glacial ages and re-dispersed northwards in interglacial ages. Certain specialization must have occurred during this process, and when the redistribution took place, specialized forms may have met with the remainder of ancestral forms and have caused hybridization. Thus, the continental pattern of differenciation is radically different from the island pattern.

For the convenience of further discussion, some abbreviations are assigned herewith.

Table 1. The process of the racial differentiation of *Chalcophora japonica* Gory.

Subspecies \ Age	P	A	B	C	D	E	F	G
takarajimana	T	← AM	← BM	← CM	← DM	← EJ	← FJ	← GJ
miwai	M							
kumejimana	K	← AK						
japonica	J	← AJ	← BJ	← CJ	← DJ			
chinensis	Ch	← ACh	← BCh	← CBo	← DBo	← EBo		
bourgoini	Bo	← ABo	← BBo					
oshimana	O	← AO	← BO	← CO	← DO	← EO		

Each subspecies of *C. japonica* is shown by "T" (=*takarajimana*), "M" (=*miwai*), "K" (=*kumejimana*), "J" (=*japonica*), "Ch" (=*chinensis*), "Bo" (=*bourgoini*) and "O" (=*oshimana*). The present age is indicated by "P", and older ages when certain event took place in regard to *C. japonica* are represented by "A", "B", "C", "D", "E", "F",.. in a chronological order as shown in Table 1. If the age just before P when T was divided from M is supposed as the age A, the ancestor of these two races is represented by A-*miwai* or AM. If a similar procedure is persued for all the races, the branches of *C. japonica* will converge in one stem in the age F. If the age P is assumed as the Holocene, and, in the same way, the age A as the Wurm Glacial Age, B as the interglacial age between the Wurm and Ris, etc., the formation of this species, *japonica,* cannot be traced back before the Günz Glacial Age.

Since the formation of the Tokara Strait is considered by geologists to be in the Günz Glacial Age or before that, the formation of *oshimana,* the first subspecies differenciated in the species, *japonica,* must have occurred in the interglacial age between the Günz and Mindel. Further process of the formation of races in *japonica* may be reconstructed as follows.

1. According to the upheaval of the Tibet Districts, the climate became cold and dry in Central Asia. The upheaval divided the genus *Chalcophora* of the Old World into western and eastern groups. Though the western group has become differentiated into several small species or subspecies in some isolated small districts of the Mediterranean area during the Glacial Age, no speciation has occurred from that time in the eastern group, although subspecific differentiation has been performed there.

2. According to the increase of the upheaval in the Tibet Districts and western China, the ancestor of *C. japonica* spread its range eastwards along the Pasific coast of the Continent in the past, which is presumed as the southeastern coast of the peninsula that existed from Formosa to the Ryûkyûs. In this age, the ancestor of *japonica* invaded the ancient Ryûkyû Peninsula. However, the invasion was barred by the formation of the Tokara Strait. The ancestor of *japonica* could not have spread northwards beyond this strait, or at least it must have been very difficult for the insect to cross the barrier. The age of this invasion seems to have been in the late Günz Glacial Age. In the same age or the interglacial age between the Günz and Mindel, the ancestor of *japonica* (GJ) also dispersed northeastwards along the northern coast of ancient East China Bay, which is supposed to agree with the –1.000 m contour line of the present East China Sea. (G stage).

3. Then the Miyako Strait opens towards the Pacific. The Amami and Okinawa groups of the Ryûkyûs became a large island. G-*japonica* left in this island changed into E-*oshimana* (EO), the ancestor of *oshimana.* In the Continent, it was divided into southern E-*bourgoini* (EBo) and northern E-*japonica* (EJ) in the later part of this age. This age may correspond to the interglacial age between the Günz and Mindel. (F stage).

4. In the next cold period, which is presumed to be the Mindel, the northern EJ was driven southwards and overlapped EBo near the southern limit of its range. (E stage).

5. During the following warm interglacial age between the Mindel and Ris, the continental E-*japonica* (EJ) was represented by southern D-*bourgoini* (DBo) changed from

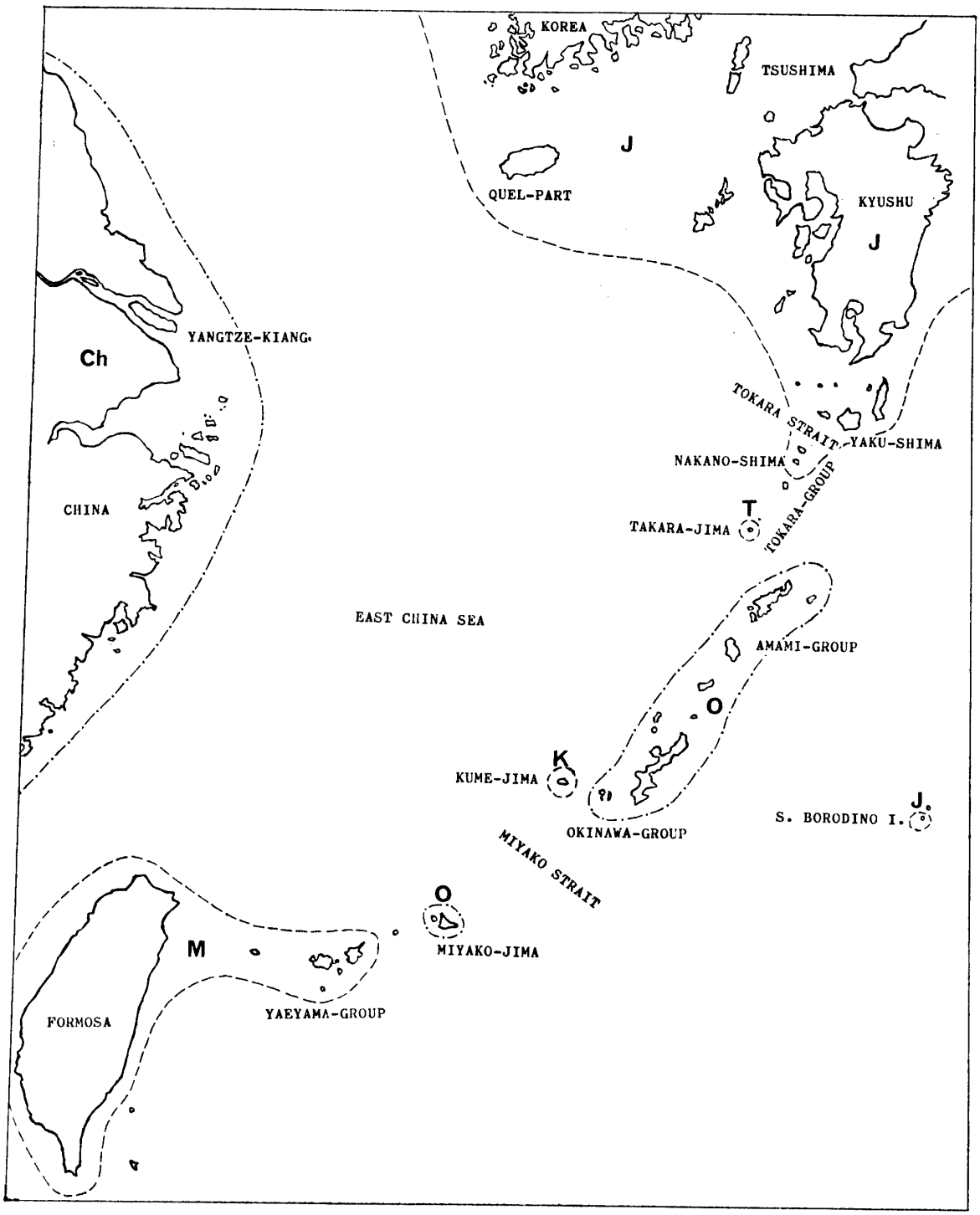


Fig. 13. The races of *C. japonica* GORY.
The abbreviations agree with those in the Table 1. ---- *miwai* group, ·—·—·— *oshimana* group.

EBo, D-*miwai* (DM), the race arisen from the hybridization between EJ and EBo and the ancestor of the present *miwai*, and D-*japonica* changed from EJ. (D stage).

6. In the following cold period, which is presumed to be the Ris, the northern DJ came down southwards again and expelled DM towards Formosa and the ancient Yaeyama Peninsula, which is supposed to have existed in an area from Formosa to the Yaeyama group of the Ryûkyûs. In the later part of this age, hybridization between DJ and DBo occurred again in the Continent. At the same time, a branch of DJ first migrated eastwards into western Japan. (C stage).

7. In the warm interglacial age between the Ris and Wurm, B-*chinensis* (BCh) arisen from a hybridization between CJ and CBo seems to have established in Central China. In this age, CM drifted from the Yaeyama group to Kume-jima and settled down there. (B stage).

8. In the last glacial age, Kume-jima was united with the main island of Okinawa, and CM which had been established just before this age, intermingled to some extent with *oshimana* that came from the main island of Okinawa, and then changed into A-*kumejimana* (AK). AM drifted from Yaeyama group reached Takara-jima of the Tokara group and settled down there. (A stage).

9. AM in Takara-jima became T of the present age. (P stage).

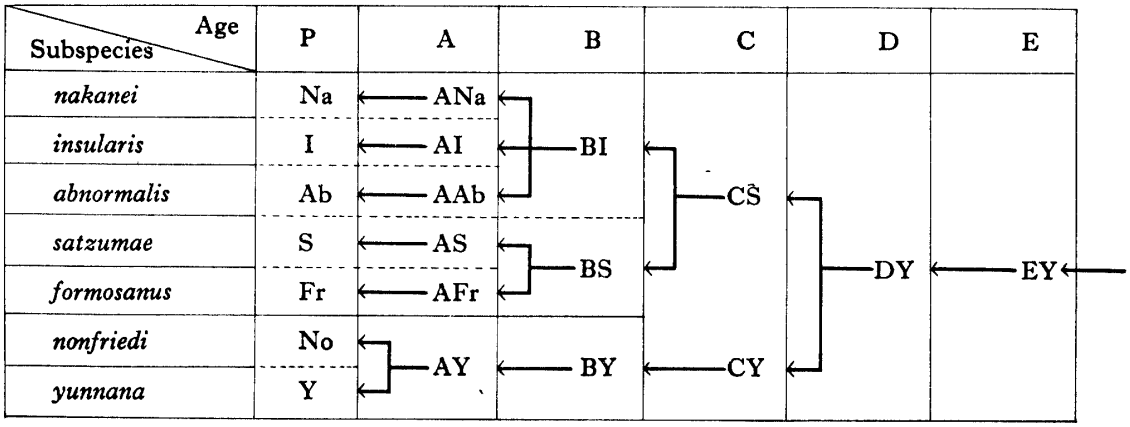
II. The Geographical Variations of *Chalcophora yunnana* FAIRMAIRE.

The local variations of *C. yunnana* are not so complicated as those of *C. japonica*. The subspecies of this species and their distribution are as follows:

yunnana	South China, Tonkin, Laos, North Thailand.
nonfriedi	West and Central China, ? Tibet.
formosana	Formosa.
satzumae	Japan (Kii Peninsula, Shikoku, Kyûshû, Tsushima, Yaku-shima, Tanega-shima), Bonin Is. (imported), Kita-Daitô-jima (=North Borodino I.) (imported).
abnormalis	Yaeyama and Okinawa groups of the Ryûkyûs, Miyako-jima, Minami-Daitô-jima (=South Borodino I.) (imported).
insularis	Amami group of the Ryûkyûs.
nakanei	Tokara group of the Ryûkyûs.

Of the races of *yunnana*, the subspecies *yunnana* and *nonfriedi* form a continental group, being characterized by the well-defined and strongly elevated elytral costae. The other group of subspecies comprises *formosana, satzumae* and three Ryûkyûan races, which have rather ill-defined and not so elevated elytral costae. The latter group can be divided into two subgroups, one of which contains *formosana* and *satzumae* having the most obsolete elytral costae and dark coloured body, and the other contains the three Ryûkyûan races having distinct elytral costae and bright coloured body. It is, however, difficult to distinguish clearly each subspecies in each group, because *nonfriedi* is a slightly differentiated northern form of *yunnana* in the Continent and there is no clear-cut distinction between *formosana* and *satzumae*. Moreover, the three subspecies in the Ryûkyûs vary gradually from *abnormalis* to *insularis* and *nakanei*. Such a mild differentiation as is shown by *yunnana* makes sharp contrast to the remarkable raciation of *japonica*. The process of differentiation in the species in *yunnana* may be as shown in Table 2. From this table, it can

Table 2. The process of the racial differenitation of *Chalcophora ynnanau* FAIMIRARE.



easily be surmised that the differentiation of this species began in later geological age than in *japonica*, and the branches of *yunnana* converge in one stem in the age D. The process of differentiation of this species may be as follows:

1. The ancestor of this species, E-*yunnana*, which may have been a form similar to the ancestral type of three races in the Ryûkyûs, is presumed to have been distributed in a more southern part of the Continent than that of *japonica*. This age may agree with the Mindel Glacial Age. (E stage).

2. Its centre of radiation seems to be in South China. E-*yunnana* changed D-*yunnana* and gradually penetrated eastwards along the southeastern Pacific coast of the ancient Continent. (D stage).

3. D-*yunnana* divided into southwestern C-*yunnana* and northeastern C-*satzumae* late in the interglacial age between the Mindel and Ris or early in the Ris. C-*satzumae* also invaded the Yaeyama Peninsula, but its further dispersal was barred by the existence of the Miyako Strait. (C stage).

4. C-*satzumae* was divided into the continental B-*satzumae* and the insular B-*insularis* early in the interglacial age between the Ris and Wurm. In the Continent, B-*yunnana*, which became differentiated from C-*yunnana*, dispersed northwards and drove B-*satzumae* out to Japan and Formosa, but B-*yunnana* could not follow B-*satzumae* due to the formation of the Formosan Strait and the East China Sea. B-*insularis* drifted from the Yaeyama group to the Amami and Tokara groups established there. (B stage).

5. B-*insularis* established in the Amami and Tokara groups became differentiated into subspecies, A-*nakanei* and A-*insularis*. *Abnormalis* of the Yaeyama group drifted to the Okinawa group and settled down there. In the northern part of the range of the continental A-*yunnana*, which was derived from B-*yunnana*, the other race *nonfriedi* became differentiated. (A stage).

The larvae of both *japonica* and *yunnana* are the borers of dead pine wood. Pine logs containing some living larvae of these species are rather frequently carried by warm current and land on unexpected places far from the normal ranges of them. If the land where reach these species is a new place for them, having favourable pine forests and moderate climate, they may easily fit in the new environment and settle down there. A female

of *satzumae* collected in the summer of 1936 at the northern part of Sado Island could be regarded as good example for the northward dispersal by the Tsushima Current from Tsushima or North Kyûshû. The distribution of *satzumae* to Tsushima may also be caused by the warm current along the western coast of Kyûshû. Accordingly, the invasion of *satzumae* to Tsushima must have occurred in a recent age when Japan was already isolated from the Continent. Moreover, since *satzumae* is not found in Korea and North China, its route of invasion into Japan may have been through a landbridge existed between Kyûshû and Central China in the Wurm and early in Postglacial Age. The dispersal of *satzumae* to Shikoku and the Kii Peninsula by the warm current, Kuroshiwo, must have taken place in a recent historical age. Moreover, even at the present time, some examples like *nakanei, insularis,* or even *abnormalis*, are sometimes found on the southern coast of Kyûshû, probably drifted from the Ryûkyûs. Since the race, *satzumae*, has already been established in Kyûshû, however, these Ryûkyûan races cannot established themselves in the same place.

As mentioned above, the common ancestor of *formosana* and *satzumae* (B-*satzumae*) is presumed to have been replaced by the common ancestor of *yunnana* and *nonfriedi* (A-*yunnana*) in the last glacial age. The age of the replacement must be after the formation of the East China Sea, that is, in the Postglacial Age. If any descendants of the common ancestor of *formosana* and *satzumae* (B-*satzumae*) are found anywhere in the basin of the Yangtzekiang, such island forms of *yunnana* as *formosana* from Formosa, *satzumae* from Japan and the three races from the Ryûkyûs could be regarded as independent species. However, the author has never examined any of such specimens from anywhere in China.

The foregoing discussion will be summarized in the following lines.

Among the species of the genus *Chalcophora* in East Asia, *oshimana* seems to be the oldest relict and its formation may possibly be traced back to the interglacial age between the Günz and Mindel.

In the geographical distribution as a whole, *japonica* is relatively northern and *yunnana* southern. The ages of invasion into the Ryûkyûs are also different between the two. *C. japonica* seems to have reached the archipelago in the Günz Glacial Age, while *yunnana* may have done so in a later age, perhaps in the Mindel Glacial Age. The difference in the pattern of present distribution between these two species may have been resulted largely from the difference in the age of invasion.

The differentiation of these two species in the Ryûkyûs after the interglacial age between the Mindel and Ris must have been strongly influenced by the warm current, Kuroshiwo. *Yunnana*, which drifted from the Yaeyama group with pine wood, could easily land on the Okinawa and Amami groups of the Ryûkyûs and establish themselves there, because there were no rivals in the central Ryûkyûs. On the other hand, *japonica*, started from the same island-group as *yunnana*, had already had an established competitor in the Okinawa and Amami groups, that is, *oshimana*. Such waifing individuals as landed on the central Ryûkyûs must have been assimilated by *oshimana*. *Japonica* has been able to survive only in such small volcanic islands as Kume-jima and Takara-jima belonging to the inner arc of the Ryûkyûs. This may be the reason why the two different patterns of distribution

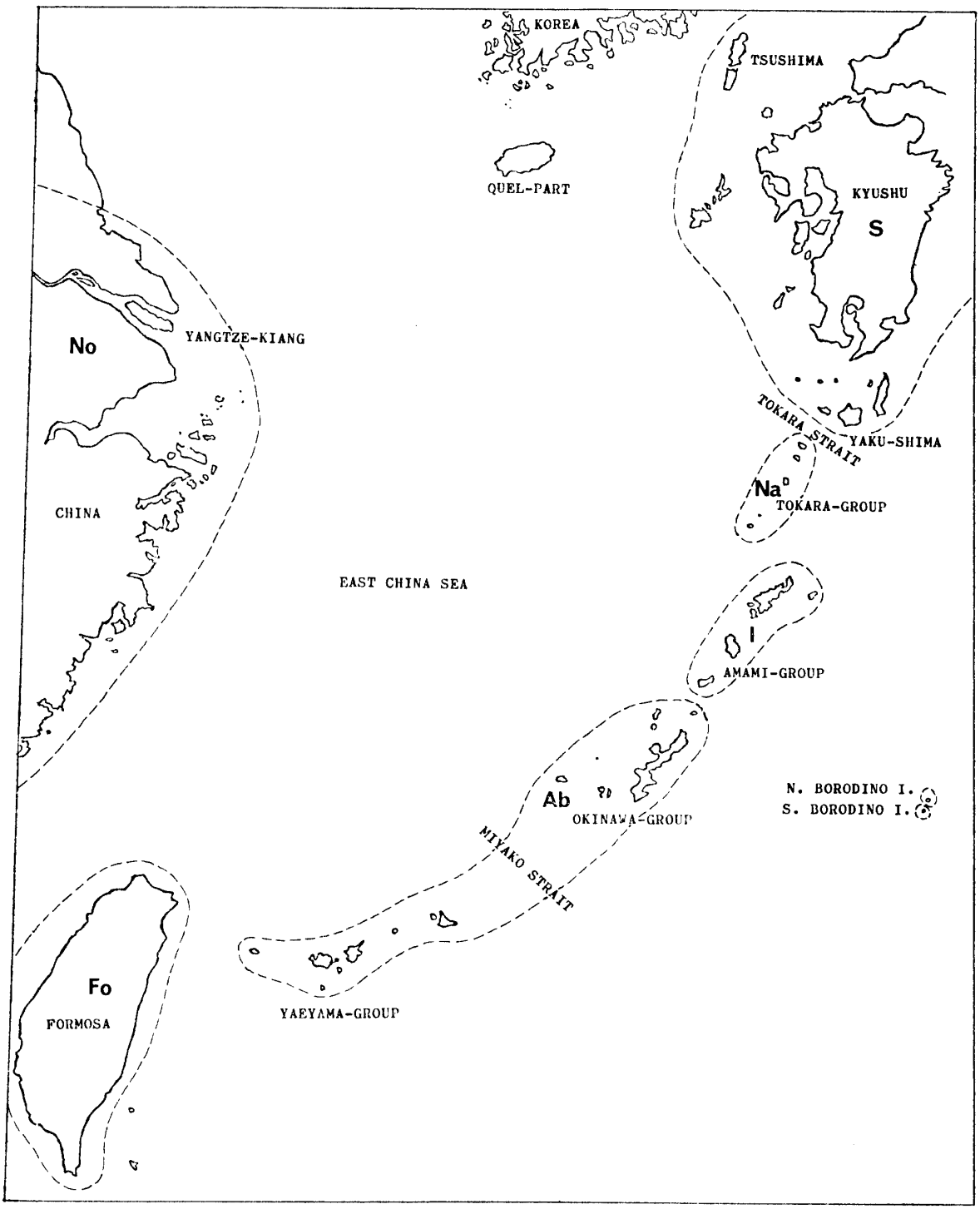


Fig. 14. The races of *C. yunnana* FAIRMAIRE.
The abbreviations agree with those in the Table 2.

in the genus *Chalcophora* have been caused in the Ryûkyûs. The faunal difference of *Chalcophora* between the inner and outer arcs of the Ryûkyûs was not caused from the

geological history of the Ryûkyûs, but from drifts on the warm current that had changed by the isolation and combination of the islands.

Through the process of invasion in the glacial ages and differentiation in the interglacial ages, the speciation and raciation was accelerated in the archipelago such as the Ryûkyûs. In the Continent on the contrary, southward immigration in the glacial ages and northward redistribution in the interglacial ages caused hybridization between new specialized forms and the remainder of ancestral forms and yielded intermediate forms. These intermediate forms eventually became established as new races. In the Continent, repetition of warm and cold ages caused advancement and recession of various forms, some of which seem to intermingles with one another and hybridized. In the fringing islands, on the contrary, movement of the races seem to have been interrupted by sea barriers. Accordingly, formation of new races caused by hybridization must have been very scarce, and old forms tend to remain as relicts.

The discussion given above is based solely upon the relationship and distribution of the existing races, although there must have been other races that had become extinct. It can be disputed as to the time of differentiation of each race, but the sequence of raciation is, the author believes, not largely mistaken.

要　　約

J. OBENEERGER (1935) によれば，チベット以東の東アジアに産するウバタマムシ属 *Chalcophora* SOLIER は5種類であるが，筆者は，ヨーロッパ各国に所蔵される模式標本を含む多くの標本を検討する機会を得，さらに手許にある日本，琉球，台湾などの多くの標本を検討した結果，東アジア産の本属の種類はウバタマムシ *C. japonica* CORY, 1840 およびサツマウバタマムシ *C. yunnana* FAIRMAIRE, 1888 の2種に整理されるべきで，その2種が地域的に多くの亜種に分化しているものである，との結論に達した．特に，琉球列島内での両種の変化は顕著で，両種共に数亜種に分けられるが，その変化の傾向は全く異り，ウバタマムシでは吐噶喇列島の中之島と日本本土に原亜種 *japonica* GORY，吐噶喇列島の宝島に特産亜種 *takarajimana* Y. KUROSAWA，沖縄群島の久米島に特産亜種 *kumejimana* Y. KUROSAWA，喜界島を含む奄美群島と沖縄群島に特産亜種のアオウバタマムシ *oshimana* SCHÖNEELDT，八重山群島と台湾に亜種 *miwai* Y. KUROSAWA を産する．これを系統的に分けると *takarajimana*, *kumejimana* および *miwai* が一群をなし，さらに *japonica* がこれに近く，*oshimana* は全く異った一見別種に見える程の特化した一群をなしている．他の群の昆虫ではこの様な場合，*oshimana* に当る奄美群島と沖縄群島のものが独立種と見做される場合が多いが，アオウバタマムシの場合には，両群の間に大陸産の2亜種 *chinensis* SCHAUFFUSS および *bourgoini* OBENBERGER を置くと両者の特徴は連続してしまい，両者を別種と見做すことは難かしくなる．両群の分布を見ると，*takarajimana*, *kumejimana*, *miwai* など *japonica* 群の各亜種は琉球列島の地質的に内帯と考えられる島々に分布し，*oshimana* は外帯と考えられる島々に限って分布する．その分布状況は琉球列島を縦に分割するような形になっている．一方，サツマウバタマムシでは，屋久島，種子島以北に亜種 *satzumae* LEWIS，吐噶喇列島に亜種 *nakanei* Y. KUROSAWA，奄美群島に亜種 *insularis* THÉRY，沖縄群島と八重山群島に亜種 *abnormalis* MIWA et CHÛJÔ，台湾に亜種 *formosana* Y. KUROSAWA を産し，このうち *satzumae* と *formosana* が互に近く，他の琉球産の3亜種がそれぞれ近似する．その分布状況は琉球列島を地史に関係なく横に分割するような形になっている．両種の琉球列島内におけるこの奇妙な分布状況の相違は，従来，他の昆虫群でしばしば論ぜられて来た様な，地質時代における島嶼の離合のみを基にしていては到底説

明が出来ない.

いま，両種の各亜種間の近縁関係から，各亜種の分化の順序を推定してみると，第1表および第2表の通りになる．すなわち，現代をP，それより一時代以前の地質時代をA，さらにその前の時代をBとし，順次C，D，E…とすると，ウバタマムシの各亜種はF時代に，サツマウバタマムシはD時代に一本の祖先型に収斂する．この一本になった時代が，恐らく両種が琉球列島に侵入して来た時代と考えられる．一般に西南方より日本や琉球に侵入した昆虫にとっては，氷期は海退による陸橋の成立によって大陸方面から西より東に分布を拡大させる時期で，間氷期は侵入者が海峡の成立によって隔離されて環境に適応して特化を進行させるか，あるいは衰退の道をたどり，ついには絶滅するかの時期であると考えられる．従って，Aをウルム氷期，Bをリス・ウルム間氷期と考えると，Dはミンデル氷期，Fはギュンツ氷期に相当する．ギュンツ氷期に西から半島状に突出していた琉球列島に沿って東漸，北上したウバタマムシの祖型は吐噶喇海峡がすでに成立していたので，ここで北上を阻止されて以北には侵入出来なかったと推定される．次のギュンツ・ミンデル間氷期に宮古海峡が成立したので，現在の沖縄，奄美両群島にまたがる地域に隔離されて特化したものがアオウバタマムシで，吐噶喇海峡以北には分布していない．サツマウバタマムシが琉球列島に侵入して来たのは次のミンデル氷期で，この時すでに宮古海峡が成立していたので，ここで北上は当然阻止された筈で，これ以北の地域へのサツマウバタマムシの分布は陸橋による分布ではなく，他の方法による侵入と考えなければならない．このことが両種の現在の分布様相を全く異ったものにした原因であると考えられる．

ウバタマムシ属の各種は幼虫が松類の枯材の材部に穿入するので，幼虫が穿入した松材が海中に漂流し，海流によって思わぬ所に漂着し，これから成虫が発生することがある．対馬から漂着したと思われるサツマウバタマムシが佐渡北端で発見されたのはその好例である．また，奄美群島型や沖縄群島型に似たサツマウバタマムシが九州南端部で時に採集されたり，ウバタマムシの緑色を帯びる個体の発見されるのは常にアオウバタマムシの漂着可能な太平洋岸沿いの地方に限られ事実も，琉球列島から漂着したサツマウバタマムシやアオウバタマムシが漂着地に先住するサツマウバタマムシやウバタマムシに同化されて，その子孫に漂着者の形質が稀に現れるものと見做してよいであろう．この様にして両種は過去，現在を問わず，常に海流によって北東方に分布を拡大する能力を有するわけであるが，漂着地に近縁の亜種がすでに存在する場合には上述の通りこれによって同化されてしまい，漂着亜種は土着することは不可能であるが，漂着地に対抗亜種が全くなく，気候も適していて十分な松林さえあれば，漂着亜種はその地に土着するのに困難は全くない筈である．この様にして，ミンデル氷期以後，八重山群島（半島）から繰り返し漂流したサツマウバタマムシが対抗種の全くいない沖縄群島以北の島々に漂着し土着して，それぞれの亜種に分化するのにそれ程長い期間を要したとは考えられないのに反し，ウバタマムシの方は沖縄，奄美両群島にはアオウバタマムシという有力な対抗亜種が存在するために，漂着してもすぐ同化されてしまい土着することが出来ず，沖縄や奄美群島の形成以後にその内側の海中に噴出した，アオウバタマムシの存在しない小火山島の久米島や宝島に漂着したものが辛うじて土着し得たに過ぎない．これが，ウバタマムシの琉球列島の内帯に見出される亜種群が互に近似するゆえんである．日本本土に見られる亜種 *japonica* は恐らくリス氷期かそれ以後に大陸から日本に侵入したもので，琉球列島の各亜種が侵入出来なかった屋久島以北の地域に拡がったのであろう．この場合問題になるのは，吐噶喇列島の中之島に産するものが *japonica* と区別出来ないことである．海流によって日本本土から中之島に漂着することは過去の地質時代においても不可能であったであろう．従って，同島と日本本土は少なくともリス氷期以後において一度は連繋していたと考えなければならない．同一種の亜種でありながら，中之島産のものが奄美大島亜種よりは日本本土亜種に近い例はウバタマムシ以外にもかなりの例が知られている．他の吐噶喇列島の島々に如何なるウバタマムシの亜種が産するか否か全く資料がないので，断定することは出来ないが，吐噶喇海峡は屋久島・口之島間よりは悪石島・宝島間の方が先に成立したのではなかろうか．地質学的にも吐噶喇海峡は宮古海峡より以前に成立し，その時代はギュンツ氷期かそれ以前と考えられているが，ウバタマムシ類の分化過程から推定される両海峡の成立時代も，この地質学か

らの推定に一致するのは当然とは云え興味深い.

次に，アオウバタマムシ *oshimana* が日本から琉球列島の内帯を経て台湾に至る亜種群と異り，大陸の中国中部からインドシナ半島に至る地域に産する亜種群に近似している理由を考察する．*oshimana* は中国南部からインドシナ半島北中部に分布する亜種 *bourgoini* と共にウバタマムシの各亜種の中では最も古い形態を残す遺存亜種であり，*oshimana* が琉球列島に隔離された後に，大陸のウバタマムシが再び南北に分裂して出来たものが，南の *bourgoini* の祖型と北の *japonica* の祖型であると考え，*chinensis* と *miwai* は，*bourgoini* と *japonica* が氷期の南下と間氷期の北上とを繰り返している間に生じた交雑型から生じた亜種であると考える．すなわち，両亜種の第1回目の交雑型が翅鞘の間室の点刻は *japonica* に似ているが翅端の形は *bourgoini* に似ている *miwai* で，第2回目の交雑型が翅鞘間室の点刻は *bourgoini* に似ているが翅端の形は *japonica* に似ている *chinensis* であろうと考えた.

サツマウバタマムシの台湾亜種 *formosana* と日本亜種 *satzumae* が最も近似している理由は，朝鮮半島と済州島には本種を全く産しないので，中国大陸の恐らく楊子江流域に形成された両亜種の共通祖型が最近の地質時代，恐らくはウルム氷期に，朝鮮半島を経ずに直接九州に侵入したものが *satzumae* で，台湾の山地に隔離されて残存したものが *formosana* であるが，大陸ではその後になって北上して来た *yunnana* に同化されてしまい，新しく *nonfriedi* が形成されたのではないかと推定される．もちろん，ウバタマムシにもサツマウバタマシにも共に絶滅して現存しない亜種があったであろうことは想像に難くないが，ここでは一応現存の亜種に基き論を進めた．大陸における亜種の形成は地理的隔離の他に，氷期，間氷期における同一種内の南下，北上の過程において，異亜種の雑交による中間型の形成，その隔離による亜種としての固定の過程が重要な役を演じていると考えられる．これに反し，琉球列島の様な大陸周辺部の島嶼では，南下，北上は不可能な場合が多く，雑交は特殊な場合を除いては不可能で，環境に適応して残存するより方法はない．この点で，亜種の形成過程は大陸と島嶼地域とでは著しい相違があると筆者は考える.

Explanation of Plate 19

1. *C. japonica japonica* GORY ♀, Kushimoto, Kii Peninsula, Japan, 2. vii. 1960. C. MORISHIMA lgt.
2. *C. japonica miwai* Y. KUROSAWA ♀, Honbukei, C. Formosa, 25. vi. 1961, T. SHIRÔZU lgt. (allotype)
3. *C. japonica oshimana* SCHÖNFELDT ♀, Kametsu, Tokuno-hsima, Ryûkyûs, 16. vii. 1961, T. SHIBATA lgt.
4. *C. japonica takarajimana* Y. KUROSAWA ♂, Takara-jima, Tokara Is., Ryûkyûs, 21. vii. 1961, Y. HAMA lgt. (holotype)
5. *C. japonica chinensis* SCHAUFFUSS ♂, Ning-po, China.
6. *C. japonica kumejimana* Y. KUROSAWA ♀, Kume-jima, Ryûkyûs, 1. viii. 1926, C. NAGAOKA lgt. (holotype)
7. *C. yunnana satzumae* LEWIS ♀, North Borodino I., Ryûkyûs, 26. ix. 1973, Y. MORIOKA lgt.
8. *C. yunnana abnormalis* MIWA & CHÛJÔ ♀, South Borodino I., Ryûkyûs, 4. vii. 19721, M. HAYASHI lgt.
9. *C. yunnana formosana* Y. KUROSAWA ♀, Honbukei, C. Formosa, 25. vi. 1961, T. SHIRÔZU lgt. (allotopotype)
10. Magnification of elytra of *C. japonica japonica* GORY
11. Magnification of elytra of *C. japonica oshimana* SCHÖNFELDT. The arrow shows the punctuation in the second and third intercostal areas between the dorsal depressions.